

(12) UK Patent Application (19) GB (11) 2 293 333 (13) A

(43) Date of A Publication 27.03.1996

(21) Application No 9518497.4

(22) Date of Filing 11.09.1995

(30) Priority Data

(31) 9418218 (32) 09.09.1994 (33) GB

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(51) INT CL⁶

B01D 35/16

(52) UK CL (Edition O)

B1D DMFX

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(58) Field of Search

UK CL (Edition N) B1D DMFX DNCE DNCF DNCG
DNCH DNCJ
INT CL⁶ B01D 25/38 35/16 35/28
ONLINE DATABASES:WPL,CLAIMS,EDOC,WPIL

(54) Method and apparatus for pumping and filtering

(57) A self-cleaning filter or screen for use with a pump has rotary backwashing jets 28 connected to the pressure side of the pump through pressure-reducing jets and serves to screen the inlet side of the pump. Rotation of the backwashing jets within the screen or filter maintains screening efficiency without the necessity to rotate the screen. The backwashing jets are of flexible construction to permit matter through to prevent blockage. Material removed from the screen or filter by backwashing is retained in a pre-screening container for draining after use.

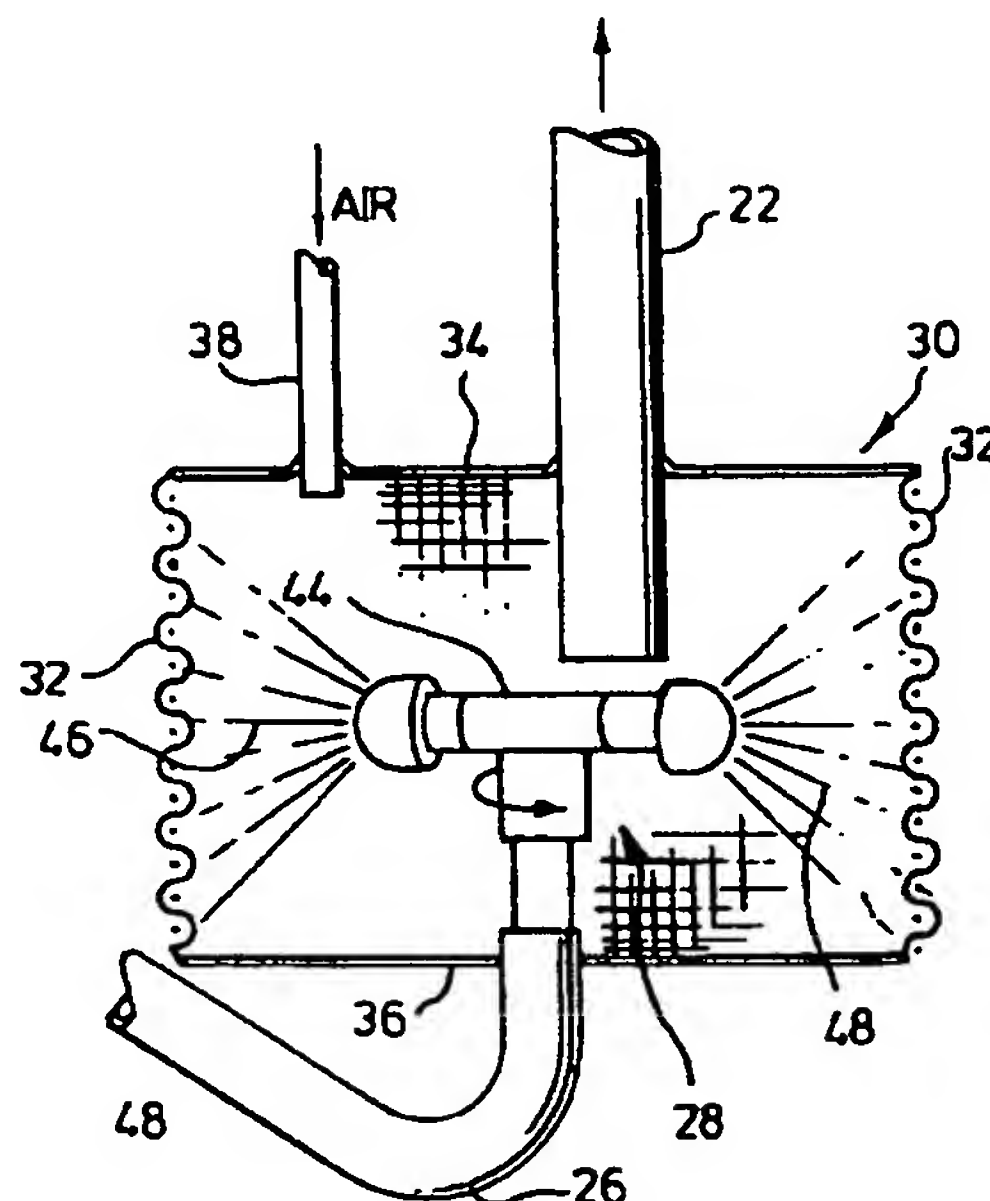
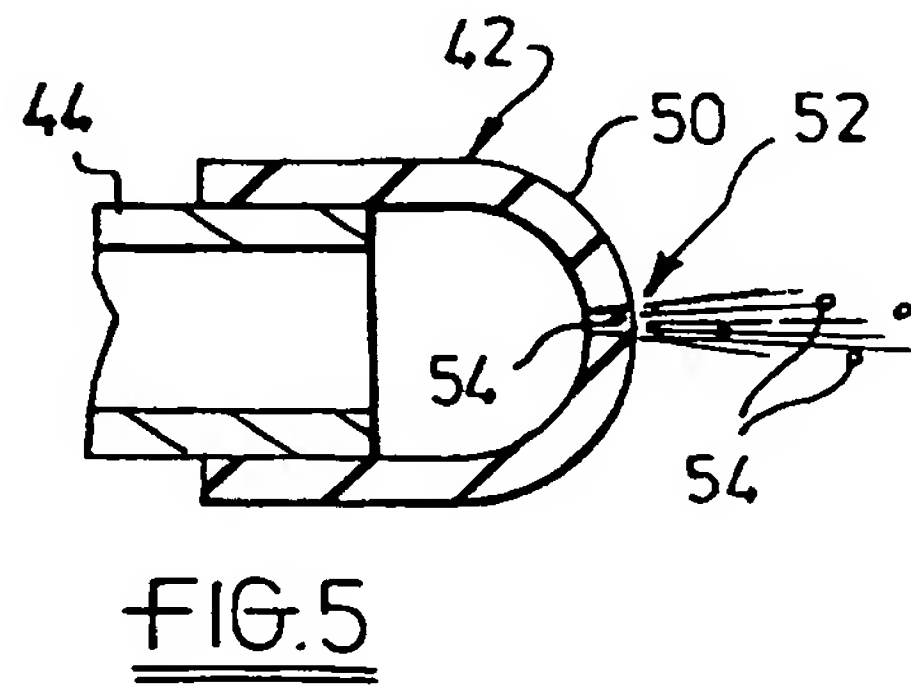
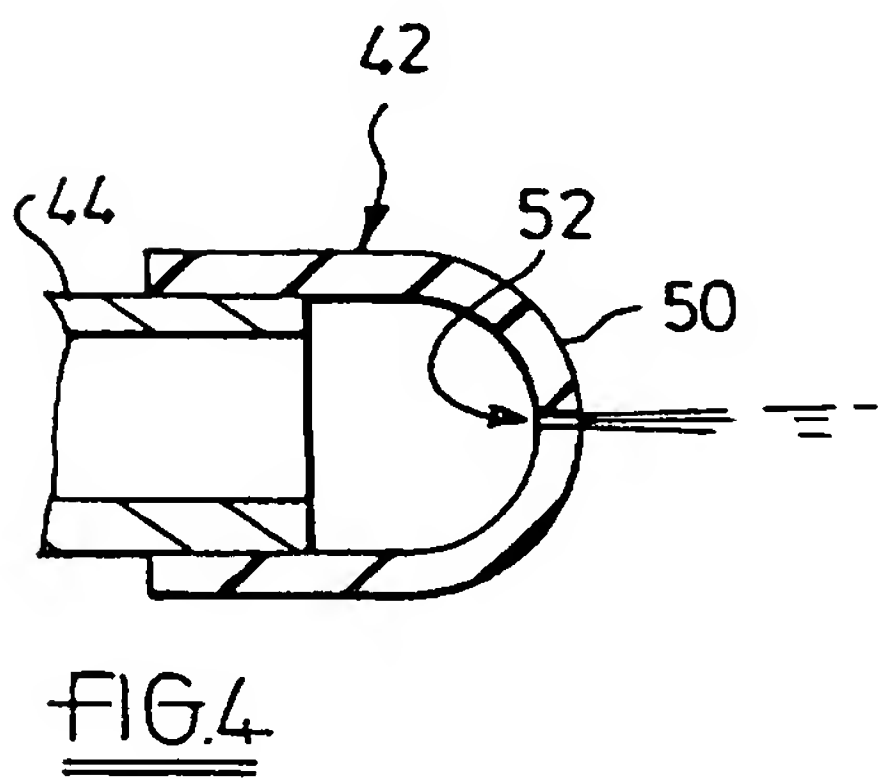
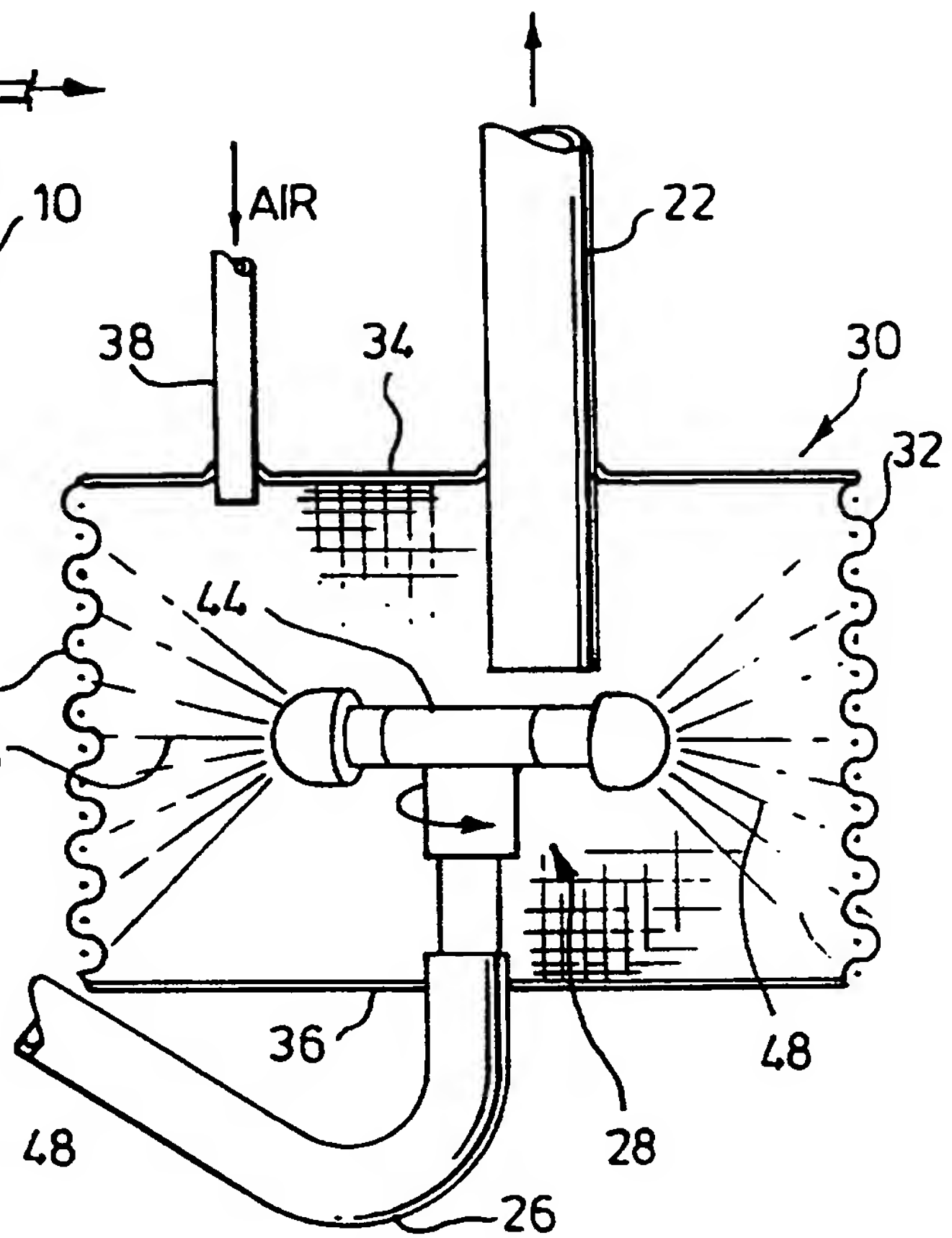
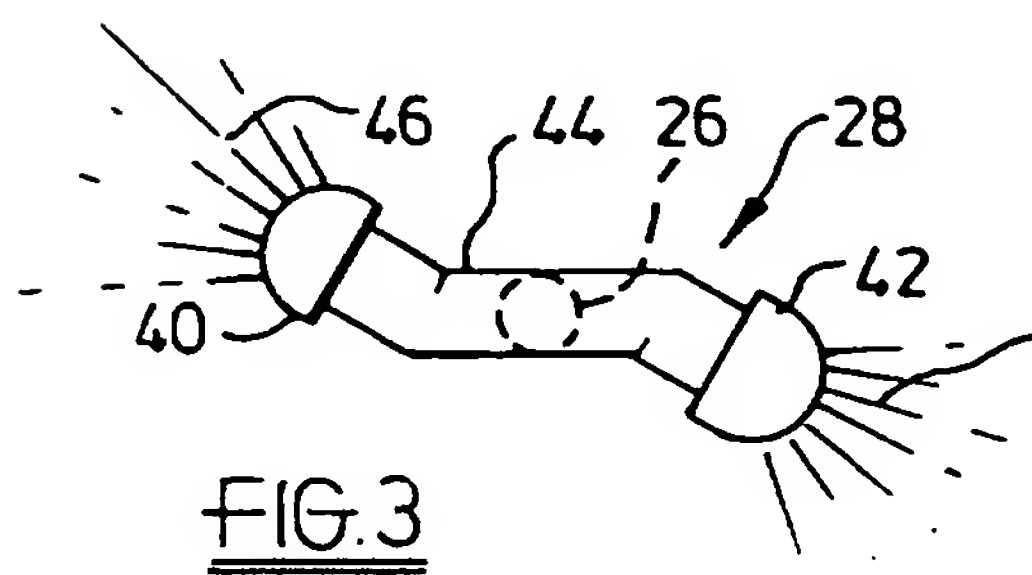
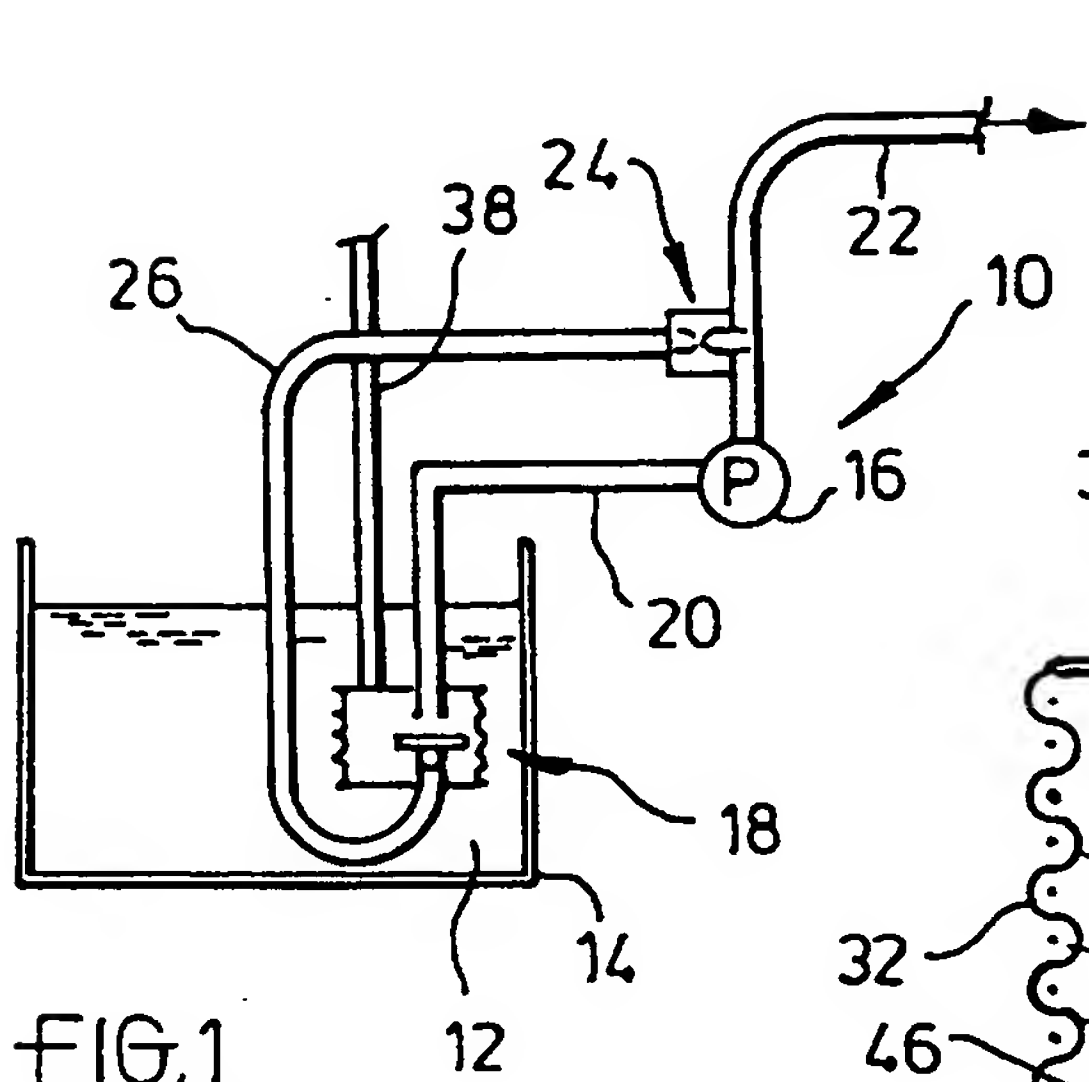


FIG. 2

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

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METHOD AND APPARATUS FOR PUMPING AND FILTERING

This invention relates to a method and apparatus for pumping and filtering liquids. An example of the application of the invention is to the pumping of slurry employing a pump and filter combination, and one aspect of the invention provides such a combination. Other aspects of the invention relate to nozzles for use in backwashing a filter, and which may be applicable to other uses, and indeed to the combination of such nozzles with a filter. Although the invention is particularly applicable to the pumping of slurry, various aspects of the invention find application considerably more widely, including such uses as the pumping and spraying of river water.

Considering first the application of the invention to the pumping of slurry and indeed, more widely to the handling of fluids containing significant amounts of suspended matter, this aspect of the invention provides a method and apparatus whereby such fluids can be handled more effectively and, notably, by means of apparatus which is less sophisticated than has been possible hitherto.

This aspect of the invention relates particularly to the pumping of intermixed liquid and solid residues from dairy farming and like activities, both into and out of a slurry lagoon and associated settling tanks. Even after settling, the liquid residues still contain appreciable amounts of suspended solid matter.

Pumps for the handling of slurry and like liquids exist of course, but tend to be costly. There is a

need for the provision of a method and apparatus offering a less costly alternative, and this aspect of the invention seeks, inter alia, to meet this need.

5 According to this aspect of the invention there is provided the combination of a self-cleaning filter system with a pump system, the filter system being provided upstream of the pump system whereby the pump is fed with filtered liquid, the pump being of the kind which is not constructed to be able to pump
10 liquids containing appreciable amounts of solid suspended matter.

The pump system can employ a relatively inexpensive pump which substantially reduces the capital cost of the system, while nevertheless being
15 able to pump and handle a liquid which has hitherto required the use of a significantly more expensive pump.

The filter system is generally as described elsewhere in this application and is connected and
20 operates accordingly.

The combination of the filter and pump system in accordance with this aspect of the invention offers significant operating and commercial advantages, notably in relation to capital equipment cost, over
25 previously available equipment known to the applicant.

Accordingly, an important aspect of the invention relates to a combination of a pump and filter whereby a pump which does not have the inherent facility to
30 handle liquids containing significant amounts of suspended solids is given that ability. However, the invention is by no means limited in its technically

significant applications to use with liquids containing substantial amounts of suspended solids. An example of an application of this latter kind relates to the filtration of river water, or the like, for use in agricultural or horticultural irrigation systems. In such applications the presence of relatively small amounts of suspended solids can lead to quite significant operational difficulties such as complete or partial blockage of one or more nozzles of the irrigation equipment. Accordingly, in general terms, the invention finds application both in systems where the principal intention is to produce a liquid from which particles above a given size have been removed, and systems in which the principal intention is to be able to pump a liquid containing significant amounts of suspended solid matter without resorting to the use of a specialist pump, conversely to remove the liquid content from a suspension to leave the solid matter above a certain size behind.

A significant technical aspect of embodiments of the present invention is the provision of the filter device on the suction side of the pump. In addition to the benefit this produces in terms of producing a filtered input to the pump, there is a further feature arising from the pressure differential between the suction and the pressure sides of the pump. Because the pressure side of the pump is at a significantly higher hydraulic pressure than the filter on the suction side, the provision of a filter backwash facility in the filter does not require the provision of a special pump for the purpose. All that is required is a suitable lead or tap from the pressure side of the pump. This is another factor which simplifies and reduces the cost of pumping systems in accordance with embodiments of the invention.

A further factor giving technical significance to the provision of the filter system on the inlet side of the pump is the following. Where a self-cleaning filter is fitted to the outlet side of the pump, as in
5 prior designs, the debris and other matter has to be removed by some mechanism, on a continuous basis. In the case where the filter is provided on the suction side of the pump, the filter and the source of such matter is conveniently close to the source of
10 unfiltered liquid, and, where appropriate, the matter can be returned to source by simple mechanical or fluid delivery means.

Accordingly, one aspect of the present invention provides the combination of a pump and an associated
15 upstream filter in accordance with one or more of the features outlined above. A second aspect of the invention provides, for use in such a filter, or otherwise, nozzles having anti-blockage operating characteristics. These characteristics are obtained
20 by providing a degree of resilience in the construction of the nozzle orifices themselves. For example, the orifices may be constructed of rubber or another elastomer. Such a nozzle construction enables backwashing of the filter with greatly reduced
25 incidence of nozzle blockage due to suspended solid matter in the liquid. Such nozzles may be applicable to other situations such as the spraying of irrigation water from rivers and like sources onto crops. In such applications, the inevitable presence of certain
30 amounts of suspended solid matter can lead to significant reductions in nozzle spraying efficiency. The provision of a nozzle facility to accommodate and discharge such solid matter can eliminate substantial periods of downtime during the operation of such
35 equipment. Accordingly, further aspects of the

invention provide such anti-blocking nozzles per se, and the combination of same with filter apparatus.

5 In embodiments of the invention described below, technically significant features include the use of the filter on the inlet side of the pump, the arrangement being such that a proportion of the filtered liquid is recirculated from the pressure side of the pump, utilising the pressure differential between the inlet and outlet of the pump.
10 Accordingly, the same pump is able to both drive the filter and carry out the main pumping operation.

A further factor is that the pump does not need to have slurry handling characteristics, but may be capable merely of handling filtered liquids. The
15 filter removes material which would damage or block the pump.

Also in the embodiments, the use of rubber nozzles to spray filtered liquid on the inside of the filter screen enables any particles left in the filter liquids to pass without blocking the nozzle. Similar
20 rubber nozzles are placed in the pipe taking a proportion of the filtered liquid from the main outlet of the pump to the filter spray nozzles. This nozzle acts as a pressure reducer without blocking.

25 A further application of the filter is for use to suck out any liquid or gas from a body of liquid or gas that is contained in a large vessel, the unwanted particles being left behind in the vessel.

Applications of the invention include the removal
30 of the liquid portion from animal waste or human sewage, the pumping of irrigation water taken from a

river or pond where the water must not contain particles above a given size, the filtering of oil taken from a sump, as in the case of internal combustion engines, or hydraulic systems, and the
5 filtering of air or gas, as in the case of engine air intakes or air conditioning systems, cooling systems as used in engine radiators, and refrigeration cooling radiators working in dusty environments.

10 In accordance with a further aspect of the invention and embodiments described below, there is provided the combination of a pump having an upstream filter with backwashing facilities for the filter derived from the pressure side of the pump. The filter is located within means such as a container for retaining filter
15 residue and which may also act as a pre-screening device for the liquid to be filtered. This aspect of the invention also provides, as such, the combination of a filter and a device for containing residues from the filter, adapted to be connected as aforesaid.

20 By providing the combination of an upstream filter and an associated filter residue device there is provided the valuable facility of upstream filtering with respect to the pump, in combination with an easy recourse to filter backwashing, and
25 without the expected disadvantage of undue contamination arising from the carrying-out of the backwashing operation. The container or the like surrounding the filter serves to retain the majority of the residue from the filter during the backwashing
30 operation. After backwashing has been carried out, the residues drop to the base of the container and no longer plug the filter.

This aspect of the invention is particularly applicable to use in such situations as filtering milk from a milking parlour prior to cold storage, and likewise to aquarium and pond filtration.

5 There is disclosed in :-

 US 4,822,486 (Wilkins) a rotary self-cleaning strainer in which fixed backwashing jets fed from the pressure side of the pump not only backwash the strainer itself but also cause it to rotate. This
10 arrangement is subject to the shortcoming that the screen itself has to be arranged in use so that it is not prevented from rotating. This is a severe restriction on the mode of use of the apparatus. Further limitations of this prior proposal include the
15 strong probability that the backwashing jets will block during use and the fact that the apparatus is not applicable to situations where it is desirable to be able to remove the backwashed foreign matter from the system, rather than just returning it to the main
20 body of liquid.

 According to the invention there is provided a method and apparatus as defined in the accompanying claims.

 By providing a stationary screen or filter and
25 moving backwashing means, the apparatus and method of the invention provides considerable simplification of the apparatus disclosed in the prior Wilkins specification, and costs are correspondingly reduced. There is no need for rotary sealing arrangements
30 between the screen and its associated structures. Furthermore, the screen can rest on adjacent structures without impeding operation.

By providing flexible or resilient or self-regulating nozzles in the backwashing apparatus, the hitherto inevitable plugging of these nozzles by materials such as slurry is greatly reduced.

5 By the provision of a container for the backwashed material, the latter can be conveniently collected and removed.

10 In one corresponding embodiment, the filter or screen and backwashing assembly is located in a housing forming part of the pipeline between a main container for liquid to be filtered (such as milk) and a pump therefor. A drain facility is provided in the housing enabling dislodged foreign matter to be drained therefrom at intervals.

15 In another embodiment, intended for use in an aquarium, the container or retaining means for the foreign matter removed in the backwashing operation is itself formed of screening material and forms a pre-screening container around the main filter or
20 screen. Aquarium water entering the outer container passes through the inner screen and when backwashing occurs, the foreign matter removed from the inner screen remains contained within the outer container and can be readily removed from the aquarium with the
25 entire assembly after disconnecting the pipe to the suction side of the pump and the pipe providing a bleed from the pressure side of the pump. The latter delivers its main flow back into the aquarium for circulation purposes. In this way there is provided
30 a convenient and self-cleaning filter assembly for aquariums which can be readily removed for occasional maintenance purposes, principally to flush out foreign matter within the outer container.

Embodiments of the invention will now be described by way of example with reference to the accompanying drawings in which:

5 Fig 1 is a somewhat diagrammatic representation of a pump and filter assembly together with an associated tank containing liquid to be pumped;

Fig 2 shows a section through the filter assembly of the apparatus of Fig 1;

10 Fig 3 shows a plan view of a rotary spray head assembly of the filter of Fig 2, the direction of viewing being axially with respect to the rotation of the sprayhead;

15 Figs 4 and 5 show enlarged sectional views of the spray nozzles of the filter assembly of Figs 2 and 3 illustrating the anti-blockage characteristics of the resilient nozzles thereof.

20 As shown in Fig 1, apparatus 10 for pumping slurry 12 contained in a pit or lagoon 14 comprises a pump 16 having a filter assembly 18 connected by a conduit 20 to the suction side of the pump, and having a pressure side discharge conduit 22 to discharge liquid for further processing, storage or agricultural/horticultural use.

25 As also shown in Fig 1, the pressure side of pump 16 is connected via a pressure-reducing lead nozzle 24 and a return conduit 26 to a backwashing nozzle assembly 28 to be more fully described below.

Broadly speaking, the apparatus operates as follows. Pump 16 draws via conduit 20 and filter 18

a filtered supply of liquid from lagoon 14 and delivers this via the pressure side conduit 22. A tapping of filtered liquid from conduit 22 feeds the backwashing nozzle assembly 28 via return conduit 26.
5 Nozzle assembly 28 backwashes the filter 18 and prevents blockage thereof. The apparatus comprises further anti-blockage features to be more fully described below.

As shown in Fig 2, filter 18 comprises a filter
10 drum 30 having a cylinder 32 of screen material and closing circular end plates 34,36 into which conduits 26 and 22 are sealed. A further air conduit 38 which, as shown in Fig 1, opens to atmosphere is also provided.

15 Backwashing nozzle assembly 28 is connected to conduit 26 and comprises a pair of nozzles 40, 42 mounted on a cranked connection tube 44 whereby the offset jets 46, 48 produce a turning moment acting in the anti-clockwise direction as seen in Fig 3, whereby
20 the nozzle assembly rotates.

Nozzles 40 and 42 each have a resilient nozzle head 50 having an orifice 52 defining a resiliently deformable opening which can distort as shown in Fig 5 to permit solid particles 54 to pass therethrough.
25 A similar jet and nozzle is provided at bleed nozzle 24 leading to return conduit 26.

The generalities of the in-use situation have already been described. Specifically, the offset jets 46 and 48 prevent blockage of screen 32. The filtered
30 liquid drawn via conduit 22 into the suction side of pump 16 is delivered by conduit 22 on the pump's pressure side. The tapping from this pressure side

flows via pressure-reducing nozzle 24 and provides a fluid flow to backwashing nozzle assembly 28 whereby the process is repeated. The resilient form of nozzles 50 prevents blockage of these by the slurry particles.

5

CLAIMS :-

1 A self-cleaning filter or screening system for a pump comprising :-

a) a screen or filter;

5 b) backwashing means for said screen or filter;

c) means for effecting relative movement between said backwashing means and said screen or filter;

characterised by

10 d) said means for effecting relative movement between said screen or filter and said backwashing means comprising means for moving said backwashing means with respect to said screen or filter, the latter being stationary.

15 2 A self cleaning filter or screening system for a pump characterised by a stationary screen or filter and movable backwashing means.

20 3 Apparatus according to claim 1 or claim 2 characterised by said means for effecting relative movement being adapted to be connected to the pressure side of a pump, and said filter or screen being adapted to be connected to the suction side of a pump.

25 4 Apparatus according to any one of the preceding claims characterised by said backwashing means comprising a jet adapted to rotate within a structure defined by said filter or screen.

5 Apparatus according to claim 4 characterised by said jet being disposed so that it is self-rotating by virtue of the action of said jet.

30 6 Self cleaning filter or screening apparatus for a pump substantially as described herein with reference to the accompanying drawings.

7 A method of operating self-cleaning filter or screening apparatus comprising moving a backwashing jet with respect to a stationary screen or filter.

5 8 Self-cleaning filter or screening apparatus comprising :-

- a) a screen or filter;
- b) backwashing means for said screen or filter; characterised by
- 10 c) said backwashing means for said screen or filter comprising a backwashing jet having an orifice which can open to allow particles to pass through rather than to block said jet.

15 9 Apparatus according to claim 8 characterised by said jet comprising a flexible material.

10 Apparatus according to claim 9 characterised by said jet comprising a resilient material.

20 11 Apparatus according to claim 10 characterised by said jet being adapted to open progressively as the pressure supply thereto increases.

12 Self-cleaning filter or screening apparatus comprising :-

- a) a screen or filter;
- b) backwashing means for said screen or filter; characterised by
- 25 c) a container to catch and retain foreign matter removed by said backwashing means from said screen or filter.

30 13 Apparatus according to claim 12 characterised by said container comprising a pre-screening device at least partially enclosing said screen or filter.

14 Apparatus according to claim 12 or claim 13 characterised by said container being adapted to be located within the main body of a liquid to be filtered.

5 15 Apparatus according to claim 12 or claim 13 characterised by said container being adapted to be located in a pipeline from the main body of said liquid to said pump.

10 16 Apparatus according to any one of claims 12 to 15 characterised by means for removing said foreign matter from said container.

17 Apparatus according to claim 16 characterised by said means for removing said foreign matter comprising drain means.

Patents Act 1977 Examiner's report to the Comptroller under Section 17 (The Search report)	<div style="text-align: right; margin-right: 20px;"><u>15</u></div> Application number GB 9518497.4
Relevant Technical Fields (i) UK Cl (Ed.N) B1D (DMFX, DNCE, DNCF, DNCG, DNCH, DNCJ) (ii) Int Cl (Ed.6) B01D - 035/16; 35/26; 25/38; 29/02; 33/04 Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) ONLINE DATABASES: WPI, CLAIMS, EDOC, WPIL	Search Examiner A J RUDGE Date of completion of Search 18 DECEMBER 1995 Documents considered relevant following a search in respect of Claims :- 1-5 AND 7

Categories of documents

X: Document indicating lack of novelty or of inventive step.	P: Document published on or after the declared priority date but before the filing date of the present application.
Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.	E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.
A: Document indicating technological background and/or state of the art.	&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages	Relevant to claim(s)
X	GB 2157964 A (SWINNEY ENGINEERING LTD) see Figure 1 and abstract	1-5, 7
X	GB 1485989 (PLENTY GROUP) eg page 2 line 43 et seq	1-5, 7
X, P	EP 0623372 A1 (FILTRATION LTD) see page 3 line 31 et seq	1-5, 7
X	US 4404106 (CHEMAP) eg Claim 1 and abstract	1-5, 7
X	US 4230576 (CHEMAP) see Claim 1 and abstract	1-5, 7
X	US 4085051 (KAMINSKY ET AL) see abstract	1-5, 7
X	US 4042504 (MARDEKI DRORI) see abstract and column 1 lines 25 et seq	1-5, 7

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